

## CLAIMS

What is claimed is:

- 1           1.     A method comprising:
  - 2                 grouping single fields of a multiple-field source into a search target having
  - 3                 multiple-field keys (MFKs) whose single fields correspond to the single fields in
  - 4                 multiple-field vectors (MFVs) of entries in a data structure;
  - 5                 generating a set of queries based, at least in part, on the MFKs, wherein each
  - 6                 query has a different MFK as a lead MFK;
  - 7                 using a query to determine whether the non-wildcard values in the MFVs of an
  - 8                 entry match the non-wildcard values in corresponding MFKs of the search target; and
  - 9                 using, if no entry has non-wildcard values in the MFVs that match the
  - 10                corresponding non-wildcard values in the MFKs, the queries to determine whether the
  - 11                entry has non-wildcard values in a MFV that match the non-wildcard values in a
  - 12                corresponding lead MFK, plus remaining MFVs that match corresponding remaining
  - 13                MFKs based on matching the non-wildcard values and wildcard values.
- 1           2.     The method of claim 1, wherein the entries of the data structure are stored
- 2                 such that the MFVs that have non-wildcard values are located at the end of the entry.
- 1           3.     The method of claim 1, further comprising arranging the entries of the
- 2                 data structure so that the MFVs that have non-wildcard values are placed at the end of the
- 3                 entry.

1           4.       The method of claim 1, wherein the non-wildcard values comprise a fixed  
2 value and/or a range of fixed values.

1           5.       The method of claim 1, further comprising:  
2           locating the entry having non-wildcard values in the MFV that match the non-  
3 wildcard values in the corresponding lead MFK, plus remaining MFVs that match  
4 corresponding remaining MFKs based on matching the non-wildcard values and wildcard  
5 values; and  
6           performing an operation associated with the located entry.

1           6.       The method of claim 1, wherein the multiple-field source comprises a data  
2 packet having single fields in its header.

1           7.       The method of claim 6, wherein the operation comprises one of the  
2 following: dropping the data packet, mirroring, metering, traffic shaping, rate limiting,  
3 accounting, statistics gathering, providing quality of service (QoS), redirecting to a  
4 central processing unit (CPU) for further processing, or sampling a subset of the packets  
5 to a CPU.

1           8.       The method of claim 1, wherein fewer than all MFVs in the entries  
2 include one single field.

1           9.       The method of claim 1, wherein the MFVs in the entries include two or  
2 more single fields.

1           10.     An apparatus comprising:  
2           a data structure having a plurality of entries, wherein each entry has a group of  
3     multiple-field vectors that each include a number of single fields having all wildcard  
4     values or all non-wildcard values; and  
5           a search unit to group single fields of a multiple-field source into a search target  
6     having multiple-field keys (MFKs) whose single fields correspond to the single fields in  
7     multiple-field vectors (MFVs) of entries in a data structure, generate a set of queries  
8     based, at least in part, on the MFKs, wherein each query has a different MFK as a lead  
9     MFK, use a query to determine whether the non-wildcard values in the MFVs of an entry  
10    match the non-wildcard values in corresponding MFKs of the search target; and use, if no  
11    entry has non-wildcard values in the MFVs that match the corresponding non-wildcard  
12    values in the MFKs, the queries to determine whether the entry has non-wildcard values  
13    in a MFV that match the non-wildcard values in a corresponding lead MFK, plus  
14    remaining MFVs that match corresponding remaining MFKs based on matching the non-  
15    wildcard values and wildcard values..

1           11.     The apparatus of claim 10, wherein the entries of the data structure are  
2     stored such that the MFVs that have non-wildcard values are located at the end of the  
3     entry.

1           12.     The apparatus of claim 10, wherein the search unit arranges the entries of  
2     the data structure so that the MFVs that have non-wildcard values are placed at the end of  
3     the entry.

1           13.     The apparatus of claim 10, wherein the non-wildcard values comprise a  
2     fixed value and/or a range of fixed values.

1           14.     The apparatus of claim 10, wherein the search unit locates the entry  
2     having non-wildcard values in the MFV that match the non-wildcard values in the  
3     corresponding lead MFK, plus remaining MFVs that match corresponding remaining  
4     MFKs based on matching the non-wildcard values and wildcard values; and performs an  
5     operation associated with the located entry;

1           15.     The apparatus of claim 10, wherein the multiple-field source comprises a  
2     data packet having single fields in its header.

1           16.     The apparatus of claim 15, wherein the operation comprises one of the  
2     following: dropping the data packet, mirroring, metering, traffic shaping, rate limiting,  
3     accounting, statistics gathering, providing quality of service (QoS), redirecting to a  
4     central processing unit (CPU) for further processing, or sampling a subset of the packets  
5     to a CPU.

1           17.     The apparatus of claim 10, wherein fewer than all MFVs in the entries  
2     include one single field.

1           18.     The apparatus of claim 10, wherein the MFVs in the entries include two or  
2     more single fields.

1           19.     An article of manufacture comprising:  
2           a machine-accessible medium including thereon sequences of instructions that,  
3     when executed, cause an electronic system to:  
4           group single fields of a multiple-field source into a search target having multiple-  
5     field keys (MFKs) whose single fields correspond to the single fields in multiple-field  
6     vectors (MFVs) of entries in a data structure;  
7           generate a set of queries based, at least in part, on the MFKs, wherein each query  
8     has a different MFK as a lead MFK;  
9           use a query to determine whether the non-wildcard values in the MFVs of an  
10    entry match the non-wildcard values in corresponding MFKs of the search target; and  
11           use, if no entry has non-wildcard values in the MFVs that match the  
12    corresponding non-wildcard values in the MFKs, the queries to determine whether the  
13    entry has non-wildcard values in a MFV that match the non-wildcard values in a  
14    corresponding lead MFK, plus remaining MFVs that match corresponding remaining  
15    MFKs based on matching the non-wildcard values and wildcard values.

1           20.     The article of manufacture of claim 19, wherein the entries of the data  
2     structure are stored such that the MFVs that have non-wildcard values are located at the  
3     end of the entry.

1           21.     The article of manufacture of claim 19, wherein the machine-accessible  
2     medium further comprises sequences of instructions that, when executed, cause the

3 electronic system to arrange the entries of the data structure so that the MFVs that have  
4 non-wildcard values are placed at the end of the entry.

1 22. The method of claim 19, wherein the non-wildcard values comprise a  
2 fixed value and/or a range of fixed values.

1 23. The article of manufacture of claim 19, wherein the machine-accessible  
2 medium further comprises sequences of instructions that, when executed, cause the  
3 electronic system to:

4 locate the entry having non-wildcard values in the MFV that match the non-  
5 wildcard values in the corresponding lead MFK, plus remaining MFVs that match  
6 corresponding remaining MFKs based on matching the non-wildcard values and wildcard  
7 values; and  
8 perform an operation associated with the located entry.

1 24. The article of manufacture of claim 19, wherein the multiple-field source  
2 comprises a data packet having single fields in its header.

1 25. The article of manufacture of claim 24, wherein the operation comprises  
2 one of the following: dropping the data packet, mirroring, metering, traffic shaping, rate  
3 limiting, accounting, statistics gathering, providing quality of service (QoS), redirecting  
4 to a central processing unit (CPU) for further processing, or sampling a subset of the  
5 packets to a CPU.

1           26.     The article of manufacture of claim 19, wherein fewer than all MFVs in  
2     the entries include one single field.

1           27.     The article of manufacture of claim 24, wherein the MFVs in the entries  
2     include two or more single fields:

1           28.     A system, comprising:  
2           a processor;  
3           a network interface coupled with the processor; and  
4           an article of manufacture comprising a machine-accessible medium including  
5     thereon sequences of instructions that, when executed, cause an electronic system to:  
6           group single fields of a multiple-field source into a search target having multiple-  
7     field keys (MFKs) whose single fields correspond to the single fields in multiple-field  
8     vectors (MFVs) of entries in a data structure;  
9           generate a set of queries based, at least in part, on the MFKs, wherein each query  
10    has a different MFK as a lead MFK;  
11          use a query to determine whether the non-wildcard values in the MFVs of an  
12    entry match the non-wildcard values in corresponding MFKs of the search target; and  
13          use, if no entry has non-wildcard values in the MFVs that match the  
14    corresponding non-wildcard values in the MFKs, the queries to determine whether the  
15    entry has non-wildcard values in a MFV that match the non-wildcard values in a  
16    corresponding lead MFK, plus remaining MFVs that match corresponding remaining  
17    MFKs based on matching the non-wildcard values and wildcard values.

1           29.     The method of claim 28, wherein the non-wildcard values comprise a  
2     fixed value and/or a range of fixed values.

1           30.     The article of manufacture of claim 28, wherein the multiple-field source  
2     comprises a data packet having single fields in its header.